



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NEW ENGLAND - REGION I
1 CONGRESS STREET, SUITE 1100 (HBT)
BOSTON, MASSACHUSETTS 02114-2023

April 27, 2004

Lonnie Monaco (monacolj@efane.northdiv.navy.mil)
Engineering Field Activity Northeast, Naval Facilities Engineering Command
Code 1821/LM, 10 Industrial Highway, Mailstop 82
Lester, PA 19113-2090

Re: *Draft Monitoring Event 23 for Sites 1 and 3 and the Eastern Plume, Naval Air Station, Brunswick, Maine*

Dear Mr. Monaco:

Pursuant to § 6 of the Naval Air Station Brunswick, Maine Federal Facility Agreement dated October 19, 1990, as amended (FFA), the Environmental Protection Agency has reviewed the subject document and comments are below:

General Comments:

1. Event 23 sample collection and analysis was complete. Results are generally consistent with recent trends (see, e.g., Appendices C.3 and C.4), particularly for VOCs. At mid-plume well MW-331, the current maximum in total VOCs, 1,1,1-TCA increased slightly over ME22, and TCE decreased slightly. Total VOCs increased over ME22, continuing an apparent seasonal fluctuation (lower in the spring round, higher in the fall round) observed for the past three years. Overall, there still appears to be a long-term increasing trend at MW-331. At P-106, which was previously the highest-VOC well in the program, 1,1,1-TCA and TCE were stable relative to ME22, and still consistent with the longer-term decline observed over the past seven years. These observations support the interpretation that the center of mass in the plume "core" continues to shift in the downgradient direction.

2. MW-313, near Mere Brook at the SE margin of the plume, shows a continued increase in total VOCs, dominated by an increase in 1,1-DCE. This is consistent with the conclusion that the leading edge of the plume is still evolving, and supports the recent proposal by Navy to perform further characterization in this area. In addition, this observation supports the recommendation contained in the monitoring report (p. 36) to perform additional surface water sampling and analysis to quantify potential impacts of discharging contaminated groundwater.

Specific Comments:

3. **p. 6, sec. 1.4.1, third bullet:** The third analyte listed is Cr by ICP. The second bullet lists the TAL, which includes Cr. Is the intent here to list the full TAL only as it pertains to Sites 1 and 3, and Cr separately as it pertains to the Eastern Plume? Please clarify.

4. **p. 9, sec. 1.6:** A number of wells were sampled for both the LTM program (by passive diffusion samplers) and the MNA assessment (by the low-flow protocol). This offers another opportunity to

examine the differences in field parameters when measured downhole following extraction of the diffusion samplers, versus in a flow-through instrument following the low-flow purge. As noted previously, there are significant disparities, particularly in the redox indicators, as can be seen in the following table:

well	low-flow (10/21-22)		downhole (10/2-15)	
	DO	ORP	DO	ORP
MW-231B	10.66	346	10.92	73
MW-318	6.44	235	0.3	-225
MW-332	7.79	305	3.43	346
MW-1104	1.3	152	2.59	247
MW-105A	10.38	219.6	10.07	167
MW-205	9.02	293	1.34	55
MW-207AR	0.12	-112	0.25	111
MW-229A	8.36	121	8.43	253
MW-230A	1.24	-135	1	306
MW-231A	10.12	197	10.1	344
MW-306	10.04	284	9.19	114
MW-319	1.5	-118	8.61	160
MW-330	0.33	-184	1.58	-143
MW-333	0.9	-48	0.59	-28
MW-334	0.3	-147	0.28	75
MW-NASB-212	0.76	-99	0.19	-115

Maximum differences in DO at the same well are as great as 7.7 mg/L, and maximum differences in ORP at the same well are as great as 460 mV. This simply serves as a reminder that these field parameters are difficult to measure, are sensitive to procedure, and should be interpreted with circumspection. Please see attached plots of ORP vs DO for the two procedures. The correlation between the two redox indicators is much better for the low-flow data, suggesting that these provide more reliable measures. The downhole data show numerous results with high ORP at relatively low DO. It appears that the chemistry of the borehole water is not representative of the adjacent aquifer.

5. p. 9, sec. 1.6: A further check on the reproducibility of field parameter results is possible, based on the repeat sampling of P-111 and P-106 by the low-flow method in both the LTM round (1-14 October, Table 7) and the MNA assessment (21-22 October, Table 10). Results for temperature, conductivity, and DO are quite consistent, but ORP data show significant differences: P-111 showed ORP at 231 mV in the LTM sampling, and at 66 mV in the MNA sampling; P-106 showed ORP at 471 mV in the LTM sampling, and at 253 mV in the MNA sampling. Although these differences (approximately 200 mV for each well) may simply reflect the well-known difficulty of obtaining reliable ORP measurements with a field instrument, they highlight the need to pay close attention to maintenance and calibration.

6. p. 10, sec. 1.7.3: *typo:* Please change "summery" to "summary."

7. p. 10, sec. 1.8.1: *typo:* Please change "... encased in concrete and burrows ..." to "... encased in concrete"

8. p. 14: The two figures appear to be identical. Please check for redundancy.

9. p. 15, sec. 2.1: The text states, "The overall monthly VOCs removed from the Eastern Plume continue to show increasing rates of VOC removal from May through October 2003, although influent concentrations decrease through the end of 2003." The statements about the rate of mass removal and

the concentration appear to be contradictory. Is the intent to state that the *cumulative mass* continues to increase, although the influent concentration is decreasing? Please revise the text for clarity.

10. **p. 19, sec. 2.3.2, MW-240:** The text notes that, "Since 2000, nickel and chromium have been steadily increasing." This may be another case of corrosion of a stainless steel pump. Note, in particular, that Cr was detected at 37.4 micrograms per liter and Ni at 27.4 B micrograms per liter. If metals in general are rising at this location due to transport in groundwater, one might expect that this would occur in conjunction with reducing conditions, high dissolved iron, and possibly low pH. However, in this round, conditions were strongly oxidizing (ORP 296 mV; DO 9.31 mg/L), iron was low (0.905 mg/L), and pH was a typical shallow groundwater value, 5.92. If there is a dedicated submersible pump in this well, it should be inspected prior to the next sampling event.

11. **p. 20, sec. 2.3.3, MW-311:** The report observes that MW-311 shows a small increase in VOCs over Event 22. While the change is relatively small, and a single-round departure from the longer-term trend is not in itself significant, it is interesting to note that the extraction rate at EW-04, immediately upgradient of MW-311, was decreased significantly between Event 22 and Event 23. January, February, and March 2003, the GWETS reports show that EW-04 was pumped at 9, 7, and 7 gpm, respectively. ME22 was carried out in April 2003. During the three months prior to ME23, EW-04 was pumped at 4, 3, and 3.3 (avg) gpm. It is possible that the lower extraction rate at EW-04 is allowing higher concentrations to pass downgradient to MW-311.

12. **p. 25, sec. 2.4.2.2, SEEP-05 :** The text remarks that manganese (58,100 micrograms per liter) and arsenic (15,700 micrograms per liter) reached new high concentrations at this location. It should be noted that iron was analyzed at 8,080,000 micrograms per liter; i.e., at 0.8 weight percent. Also, the field sheet describes the water color as "copper, red," and the turbidity was recorded at 2125.7 NTU. It seems likely that this sample was heavily loaded with iron floc, and the other elevated elements (Mg, As) are likely sorbed on the iron oxyhydroxides. These results emphasize the need to standardize the sampling of surface water and seeps in order to provide a consistent basis for comparisons of analytical results from sample to sample and/or from round to round and/or to any relevant water quality standards. Navy and regulators should discuss field filtration of surface water samples.

13. **p. 27, sec. 2.4.4.1, first bullet:** Please check units. VOC concentrations in sediment are typically given in micrograms per kilogram, as shown in the footnote to Table B-12. Should the historical maximum at LT-01 less than 100 *micrograms* per kilogram, rather than *milligrams* per kilogram?

14. **p. 30, sec. 2.5.1:** The text comments on the fate of DCE, and notes that it can be destroyed by direct oxidation downgradient of the reducing zone in which TCE undergoes reductive dechlorination. It is interesting to note that the DCE observed in the Eastern Plume is found principally at MW-331 (320 micrograms per liter), with a lesser concentration immediately downgradient at MW-311 (18 micrograms per liter). The high DCE is co-located with the second-highest TCE detection in the plume (250 micrograms per liter). Redox conditions at MW-331 are unknown because of a deviated well casing that does not allow the field probe to pass. However, the Eastern Plume domain that shows the most compelling evidence of being reducing overall is the southernmost portion (see, e.g., the methane map, Fig. 13), downgradient of MW-311. That is, the DCE does not appear to be persisting into the reducing groundwater in the southern portion of the plume, to be oxidized even farther downgradient, as suggested by the conceptual model presented here. It is possible that the central portion of the plume has become oxidizing (note, for example, that P-106, upgradient of MW-311, and the locus of another maximum in the CVOs, showed ORP of 253 mV in ME23) due to depletion of electron donor (e.g., fuel constituents), and that DCE, remnant from earlier conditions conducive to reductive dechlorination, is destroyed by aerobic

oxidation in the central domain. As more becomes known about the geochemical conditions near MW-331 (e.g., in the upcoming direct-push investigation), an effort should be made to reconcile these observations, and develop a conceptual model consistent with the data.

15. p. 31, sec. 2.5.2: The MNA assessment utilizes results from analysis for ferrous iron in the field using a Hach kit. It is worthwhile to compare results from the Hach kit to the laboratory analyses performed on the same samples:

MW	field Fe mg/L	lab Fe mg/L
105A	0	0.0805
105B	0	15.8
1104	0	2.69
205	0	1.59
207AR	1	4.62
229A	0	0.489
229B	0	0.641
230A	1.1	2.5
231A	0	2.7
231B	0	1.13
306	0	0.429
313	0	3.43
318	0	0.571
319	0	2.23
332	0	0.176
333	0.8	1.5
NASB-212	1	3.38
330	0	1.21
334	0	0.586
P-111	1.2	1.53
P-106	0	0.433

It is clear that the field test yields results that differ significantly from the lab analyses. If the Hach kit is intended only to discriminate between ferrous iron concentrations less than or greater than 1 mg/L, it succeeds for 12 of 21 samples; that is, there are eight samples for which the Hach kit yielded ND, while the corresponding lab analyses showed iron at concentrations below 1 mg/L, and there are four samples for which both the Hach kit and the lab show concentration greater than 1 mg/L. Note that the disparities among these "successes" are significant; e.g., MW-207AR, for which the Hach kit yielded 1 mg/L and the lab found 4.62 mg/L. Of the remaining samples, eight showed ND by the Hach kit, and Fe greater than 1 mg/L in the lab; the last sample showed Fe <1 mg/L by the Hach kit, and >1 mg/L in the lab. The lab results probably provide a more reliable basis for assessing dissolved iron concentrations, as long as sample turbidity is not high.

16. p. 31, sec. 2.5.2.1: The text states that potential daughter products of TCE include 1,1-DCE. While this is correct, it might also be noted that 1,1-DCE is often a minor byproduct of biodegradation of TCE, while it can be a significant daughter product of 1,1,1-TCA via abiotic degradation. Given that 1,1,1-TCA is present in the Eastern Plume at concentrations higher than TCE, caution should be exercised in interpreting 1,1-DCE as a daughter product of TCE.

17. p. 32, sec. 2.5.2.1, top: The report refers to the "... highest percentage of 1,2-DCE" Does this refer to 1,2-DCE mass concentration as a percentage of TCE at the same point? Or, is the intent to refer

simply to the concentration of 1,2-DCE? Please clarify.

18. **p. 32, sec. 2.5.2.1, top:** The text notes that "... methane was reported in seven of the samples, suggesting that reductive dechlorination of chlorinated VOCs is occurring in the southern portion of the Eastern Plume." Caution is urged in interpretation of the methane detections as evidence of reductive dechlorination. In particular, it is noted that the highest methane detections are not correlated spatially with the chlorinated VOCs. The high methane may be correlated with locations along Merriconeag Stream and Mere Brook. It is possible that natural methanogenic conditions prevail in some domains of groundwater (e.g., where subsurface peats provide abundant organic carbon), and that the methane detections have little relation to the plume.

19. **p. 32, sec. 2.5.2.1, Chloride:** The report states that chloride is elevated relative to the background well at four locations, implying that this may be a breakdown product of dechlorination. However, it should be noted that chloride from other sources (e.g., road salting, seepage from underlying marine sediments, etc.) is particularly abundant in this environment. For example, MW-218 showed sodium at 215 mg/L in ME23. It is reasonable to assume that this originates from seawater in the underlying clay, and that chloride would be found in this sample in a 1:1 molar ratio, or at a mass concentration of 330 mg/L. The additional chloride contributed by degradation of the chlorinated solvents in this system is negligible in comparison. High chloride may be found, for example, at any location with upward-discharging groundwater (note that 3 out of the 4 wells cited lie near the streams). Caution is urged in interpreting chloride concentrations with respect to the dechlorination process.

20. **p. 32, sec. 2.5.2.1, Chloride:** *typo?* Please change "MW-212" to "MW-NASB-212."

21. **p. 32, sec. 2.5.2.1, DO and ORP:** It is agreed that the southern portion of the plume, in particular, seems to exhibit low DO and low ORP, indicating reducing conditions favorable to dechlorination of CVOs. However, it is noted that the two "hotspots" in the plume pose contradictions or unknowns. In particular, P-106 shows high 1,1,1-TCA (660 micrograms per liter) and its daughter product 1,1-DCA (49 micrograms per liter), yet ORP is 253 mV and DO is 5.19 mg/L, indicating highly oxidizing conditions. At MW-331, both TCE and 1,1,1-TCA are high, as are their daughter products, 1,2-DCE and 1,1-DCA. Redox conditions are unknown at this location due to a deviated well casing that prevents use of a downhole multiparameter probe. As the conceptual model for the plume evolves, an effort should be made to reconcile observations of daughter products with conditions that do not appear to be favorable to reductive dechlorination in the plume core. (Forthcoming additional characterization in the areas of P-106 and MW-331 will contribute important information to this assessment.) One possibility is that reductive dechlorination has slowed in the core of the plume because available electron donors are depleted (note, e.g., that there the only fuel constituent detected at either of the hotspot wells in ME23 is benzene at 0.4 J micrograms per liter at MW-331). If redox conditions were favorable to reductive dechlorination in the past, but are not at the present time, the daughter products observed in the plume core may be a relic of the earlier degradation.

22. **p. 34, sec. 2.5.4:** It is agreed that the southern boundary region of the Eastern Plume appears to be the most favorable domain for reductive dechlorination. A more complete assessment of conditions in the core of the plume (e.g., near P-106 and MW-331) awaits the additional exploration planned for the near future. The conditions observed near the downgradient, leading edge of the plume suggest that active degradation may provide a "barrier" to further migration, even if biodegradation is not shown to be reducing contaminant mass in the plume core significantly.

23. **p. 34, sec. 2.5.4:** EPA requested that groundwater samples collected for the MNA assessment be

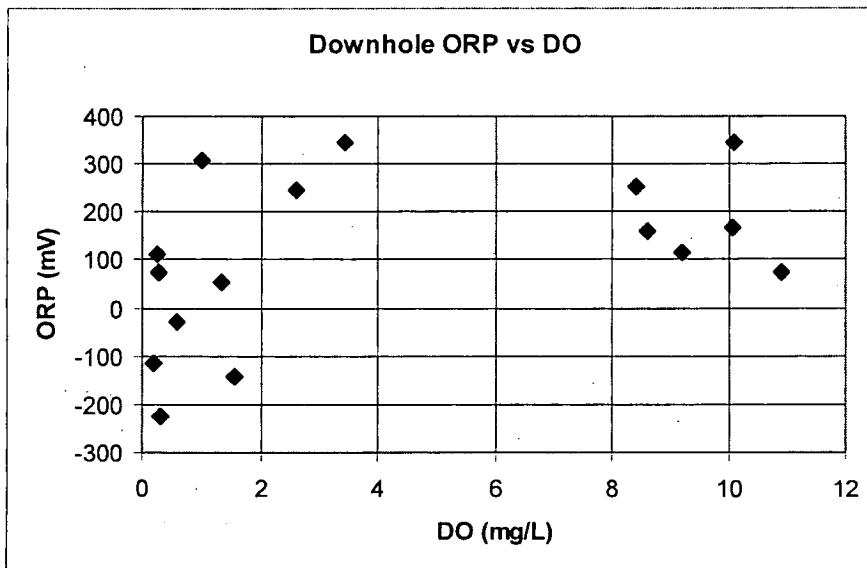
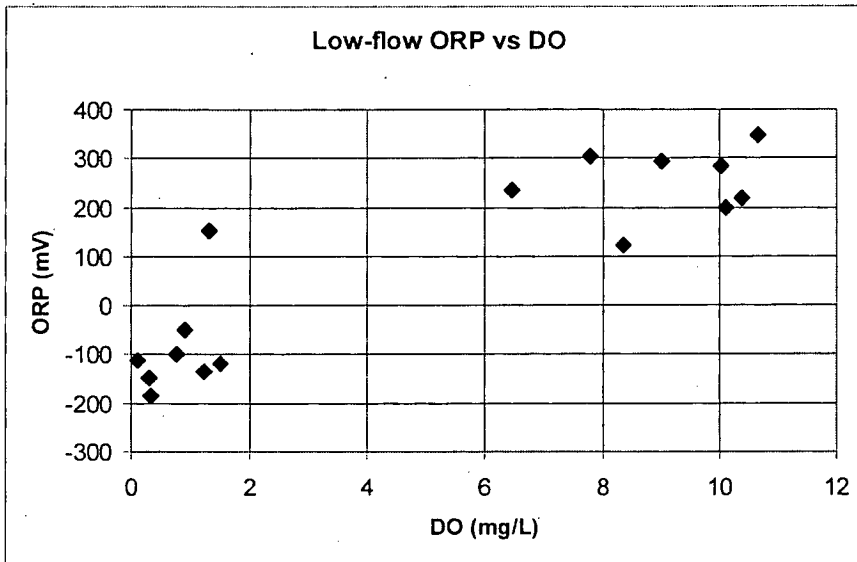
analyzed for arsenic, due to a regional concern for elevated arsenic associated with reducing groundwater. That is, the same conditions that favor reductive dechlorination of solvents also favor the dissolution of ferric oxyhydroxides, mobilizing sorbed elements, including arsenic. In this event, one expects to find high dissolved iron associated with low ORP and low DO, and high As associated with high Fe. Results from the inorganics analyses (App. H.13) and the relevant field parameters are tabulated below on the next page:

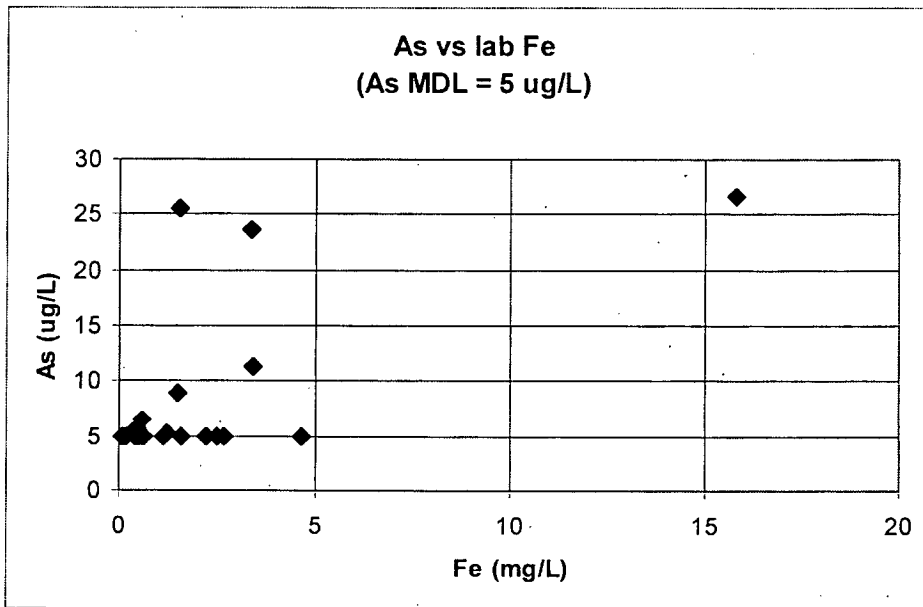
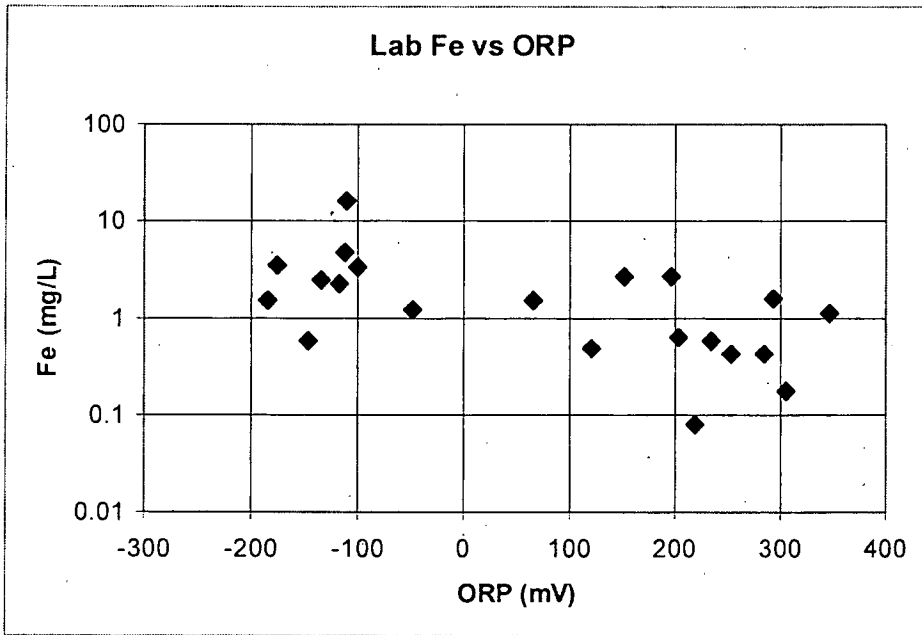
well	ORP mV	DO ppm	field Fe ppm	lab Fe ppm	lab As ppb	turb NTU
105A	219.6	10.38	0	0.0805	5	0.7
105B	-111	3.12	0	15.8	26.6	3
1104	152	1.3	0	2.69	5	2
205	293	9.02	0	1.59	5	3
207AR	-112	0.12	1	4.62	5	84
229A	121	8.36	0	0.489	5	8
229B	203	8.71	0	0.641	5	4
230A	-135	1.24	1.1	2.5	5	4
231A	197	10.12	0	2.7	5	96
231B	346	10.66	0	1.13	5	7
306	284	10.04	0	0.429	5	7.1
313	-176	0.23	0	3.43	11.3 NC	
318	235	6.44	0	0.571	5	4
319	-118	1.5	0	2.23	5	6
332	305	7.79	0	0.176	5	5
333	-184	0.33	0.8	1.5	8.9	30
NASB-212	-99.3	0.76	1	3.38	23.6	9
330	-48	0.9	0	1.21	5.2	10
334	-147	0.3	0	0.586	6.5	8
P-111	66	3.4	1.2	1.53	25.6	6
P-106	253	5.19	0	0.433	5.7	4

Inspection of the above table, as well as the attached plots, shows the expected correlation of dissolved iron with ORP, although iron concentrations in this system are not particularly high relative to other sites in the region. Higher arsenic is associated with higher iron, but the expected linear correlation is obscured by two points (MW-NASB-212 and P-111) for which the ratio of arsenic to iron appears to be somewhat high. This may be attributed to analytical uncertainty on the arsenic analyses, none of which are more than about 5 times the detection limit. Although these higher arsenic concentrations are above the MCL (10 micrograms per liter), it does not appear that reductive dissolution in this system produces arsenic at concentrations likely to carry significant risks.

24. p. 35, sec. 3.1: It is agreed that the MNA assessment shows that favorable conditions for biodegradation exist "... in some portions of the Eastern Plume." However, it remains to be seen whether or not these favorable conditions prevail where the contaminant mass is greatest. The data seem to indicate favorable conditions particularly in the southern boundary region of the plume, as noted in the document, but it is not clear that such conditions prevail throughout the "deep zone." The presence of abundant daughter products in the "hotspots" certainly suggests that conditions at least were favorable at one time. It is not clear that favorable conditions prevail at the present time. Further assessment is needed, particularly in the core of the plume, and the additional characterization planned in conjunction with modification of the extraction system (i.e., surrounding P-106 and MW-331) should contribute to this assessment.

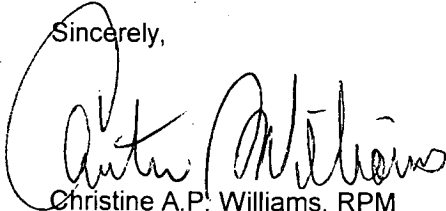
25. p. 37, sec. 3.1.1: The document recommends abandonment of EW-01. Has any thought been given to the abandonment procedure? If vertical communication along the boring is the principal concern, the sand pack will have to be addressed, as well as the well screen itself.





If you have any questions with regard to this letter, please contact me at (617) 918-1384.

Sincerely,

A handwritten signature in cursive script, appearing to read "Christine Williams".

Christine A.P. Williams, RPM
Federal Facilities Superfund Section

cc. Claudia Sait/ME DEP (claudia.b.sait@state.me.us)
Ed Benedikt/Brunswick Conservation Commission e-mail only (rbenedik@gwi.net)
Tom Fusco/BACSE e-mail only (tfusco@gwi.net)
Carolyn LePage/LePage Environmental (clepagegeo@aol.com)
Peter Golonka/Gannet-Fleming e-mail only (pgolonka@gfnet.com)
Darren Gainer/ECC e-mail only (dgainer@ecc.net)
Al Easterday/EA (aeasterd@eaest.com)
Tony Williams/NASB (WilliamsA@nasb.navy.mil)